THE TECH BEHIND AN OPTIMAL LAYOUT PROCESS

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Construction layout is the important link between design intent and structural reality. Layout professionals have a crucial job: preparing a jobsite for construction and actualizing drawings and 3D models that come from the office.

However, as a design passes through the chain of command it's possible for details to be lost in translation. When plans arrive to a layout professional, they need to be able to depend on the tools they use for interpreting and translating design models.

There are various tools and technologies that are meant to streamline the layout process and make the layout professional more efficient and accurate. But, whether these solutions actually meet the needs of those in the field or ultimately cause more harm than good remains unclear until someone actually puts the technology to use. Layout accounts for a significant portion of each project's budget, so betting on emerging tech can be a costly gamble.

When it comes to layout technology, the tools of the trade are always changing, so let's nail down the common challenges that occur during the layout process, and identify the technologies that are actually worth investing in.

CHALLENGE: LAYOUT INEFFICIENCY

Two of the greatest threats to project success are inefficient processes and outdated tools. Tradition, inertial appeal, and stubborn attitudes can keep a middling technology in the mix long after a more effective alternative appears. Just because a technology has become the industry norm doesn't necessarily mean it's the best option. This paradox is no more apparent than in the outdated technologies of layout disciplines.

It's hard to believe, but many layout professionals still use the same technologies popularized during the American Industrial Revolution. A tape measure, string, and printed plans — these tools have their time and place, but have ultimately overstayed their welcome as the primary method of marking layout points and lines.

Even some robotic total stations — for all their surveying utility — come with limitations. Total stations require multiple personnel to operate: a technician to hold a retroreflector and another to control the total station from the observed point. This means that total stations, a technology meant to improve layout efficiency, can actually put a strain on resources and keep layout professionals from handling other important tasks.

A **2018 study** on avoidable construction project expenses found that the construction industry overpays billions of dollars a year due to inefficiencies and rework. The study, which surveyed 600 construction companies, found that inefficient processes and miscommunication were leading causes of avoidable costs.

> **Time spent on non-optimal activities such as fixing mistakes, looking for project data, and managing conflict resolution accounts for $177.5 billion in labor costs per year in the U.S. alone," according to the press release.**

SOLUTION: MODERN LAYOUT EQUIPMENT

The above study outlined three universal needs that a majority of respondents experience day-to-day when on the job:

- **Better access to project data**
- **Improved project productivity**
- **Increased accuracy for project information**

The common theme that emerges from these procedural obstacles is this: construction teams need a way to improve productivity and communication. What might sound simple on paper turns out to be insurmountable in practice when you consider project budget and enduring layout workflows.

Luckily, there are two technologies that are driving layout efficiency, and addressing the above pain points. These easy-to-integrate solutions include:

- **Remote Controlled Total Stations:** A total station that can be operated by one technician, unlike traditional total stations, which require at least two or more operators. A **remote controlled total station** allows for one-person operation and essentially cuts labor requirements in half, so other layout professionals can concentrate on other tasks at the same time.
  - This technology automatically corrects points on uneven surfaces, locates wall penetrations, and, with a pole and prism setup, technicians can work around on-site obstructions.
- **3D Scanning Technology:** When a robotic total station is paired with **3D scanning technology**, construction teams can improve information delivery. Scanning technology allows technicians to add as-built data to existing constructible models and cross check the accuracy of their work against designer-approved plans. This technology helps optimize measurement accuracy and quality assurance.
  - The greatest benefit of this arrangement is that it helps align digital models with field execution. 3D models visualize all the points that need marking on-screen, so designers can rest assured that the designer's initial intent is being honored in the field.

More calculations and inspections in less time means a more efficient and accurate layout. From light topographic work to commercial construction, remote controlled total stations and 3D scanning technology help contractors overcome the inefficiencies of legacy layout technologies.

CHALLENGE: MEASUREMENT ACCURACY

Measurement accuracy is one of the most important responsibilities entrusted to the layout team. A seemingly-innocuous measurement error during the layout process can easily compound and cause significant issues in other project phases. A miscalculation, human error, misplacement, etc. — these errors and more are easy to commit but difficult to remedy.

In order to reduce measurement mishaps, layout teams need technology that is capable of carrying out the extreme precision required by a design plan. Don't put your project in the way of unnecessary risk — relying on a tape measure, level, or, worse yet, simply eyeballing points increases the likelihood of costly delays. Even the most seasoned technicians could use some measurement reassurance.

SOLUTION: AUTOMATION

According to a McKinsey report, the construction industry woefully lags behind other industries in terms of productivity. For example, productivity in manufacturing trades outpaces the construction industry by nearly 200%. The report identifies several inefficiencies that mar the industry — from communication bottlenecking, to poor organization, it's clear that the construction industry has a lot of room for improvement.

Indoor positioning systems are helping to streamline layout processes and close the industry's productivity gap by automating measurements. Designed to measure floors, walls, ceilings, electrical, mechanical, plumbing, and formwork, these technologies offer unprecedented versatility. Equipped with RFID or Wi-Fi, positioning systems identify precise layout points and can integrate this information into a larger data-collection system.

Self-locating technology helps eliminate the need for leveling by hand. This makes finding layout points as simple as the press of a button — effectively eliminating the delays associated with manual measurement and reducing the likelihood of human error.

Layout automation takes away the guesswork of measurement. This layout solution automatically measures distances and angles — making it easier to find positions and deliver accurate layouts. Thanks to measurement automation, teams can deliver accurate field results faster and reduce rework.

CHALLENGE: PROJECT CONNECTIVITY

Data silos are one of the most significant, yet avoidable, inefficiencies that inhibit construction projects. Disparate construction phases — separated by differing skills, goals, and processes — limit collaborative potential, and projects suffer from progress bottlenecking as a result.

Disconnected project phases is a result, in part, of institutional barriers. Years of operating with different software, siloed processes, and seperate locations inherently bred division. Getting all stakeholders on the same page means getting all stakeholders on the same platform.

The construction industry is notably lacking when it comes to digitization. **One study found that construction ranks second to last** — ahead of only agriculture — in terms of adaptability to new technological trends. Digital spending, digital asset stock, market making, and other digitization index criteria culminated in a shockingly low rating. This poor showing ranks construction behind hospitality, healthcare, and even government.

But, there is hope. The study identifies five realistic trends that will help promote digitization and outlines solutions that will continue to shape the future of construction for years to come.

"None of these five ideas is futuristic or even implausible," according to McKinsey.

> **All are grounded in innovations that are applicable to the construction sector and that are either being deployed or prototyped. In short, they are practical and relevant. Moreover, they are designed to work together to deliver greater impact.**

These solutions include:

1. **Higher-definition surveying and geolocation**
2. **Next generation 5-D building information modeling**
3. **Digital collaboration and mobility**
4. **IoT and advanced analytics**
5. **Future-proof design and construction**

For the purposes of layout improvements, let's focus on item #3: **Digital collaboration and mobility**. This technology helps teams move away from paper/pencil processes, share information in real-time and, ultimately, bring collaborative potential into the 21st century.

SOLUTION: COLLABORATION PLATFORM

Break down communication barriers by getting all stakeholders on one collaborative platform. Share notes, data, reports, project details and other mission-critical information on a universal repository. This helps create a direct link between design intent and construction execution by unifying all project phases on one platform.

Integrating a **digital collaboration platform** helps accommodate a variety of business and layout needs. Whether technicians need to create points on-site or work directly from a model or 2D drawing, this software offers the versatility layout teams need to get the job done.

For example, layout professionals can input layout points directly into the field software and controller. For points coming from the office, design plans can be imported from one of the many data sources, such as SketchUp, CAD or Revit. Once points are laid out in the field, technicians can confirm accuracy by comparing against 3D models and design plans directly from a tablet. This helps to ensure transparency and promotes timely progress and risk assessment.

Software of this nature can produce a variety of reports that can be shared among stakeholders to help inform future decision making and safeguard against human error:

- **Daily Layout Summary:** Day-to-day information on layout progress. This includes when layout started and finished, how many points were laid out, how many points were in tolerance, etc. This report can be used to calculate performance metrics for the day.

- **Layout Deviations:** Tracks all points that were laid out and details any design discrepancies.

- **Field Report:** An all-encompassing report that can be sent back to the office to inform future adjustments. Information can include field conditions, conflicts, requests for information, etc. The field report helps promote collaboration between those in the field and those in the office.

Software like **Trimble Connect** helps to demystify the layout process and unify all project phases under one central platform. Then, a layout solution like **Trimble Field Link** can be integrated seamlessly with other phases via Connect. Whether consulting with designers on their drawing intent, or resourcing with general contractors, Field Link helps involve layout technicians with other stakeholders and create an information feedback loop between designers and the jobsite in real time. The result is a model that is truly constructible — so accurate you can build from it.

By investing in the best technology to solve the looming challenges they face, layout professionals can vastly improve speed, efficiency, and accuracy of the layout process, and contribute to the profitability and success of their companies.

Trimble offers an **extensive array of layout solutions** that specifically accommodate building contractors and engineers. We develop solutions to make the jobs of all trades more efficient, accurate, and connected.